MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

DCE5038 – ELECTRICAL MEASUREMENT AND INSTRUMENTATION TECHNIQUES

(ALL GROUPS)

24 OCTOBER 2017
9.00 a.m. –11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **4** pages.
2. Answer **ALL** questions.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [25 MARKS]

a) Give the definition of measurement system.

[2 marks]

b) Figure 1 shows an analog moving-coil ammeter.

i) Explain the three basic elements of measurement system.

[6 marks]

ii) Identify the functional elements of the instrument in Figure 1.

[3 marks]

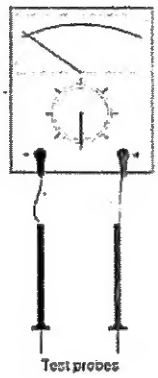

Figure 1

c) Explain and write the formula for the following terms:

i) Static error.

[3 marks]

ii) Relative static error.

[3 marks]

d) Convenience is one of the aspects that needs to be considered in selection of instruments. Define **two** conditions of instrument that are considered to be convenient.

[4 marks]

e) Explain the differences between monitoring type and controlling type instruments.

[4 marks]

Continued...

QUESTION 2 [25 MARKS]

a) State **three** indicating instruments that can be used in direct current measurement.

[3 marks]

b) Attraction type moving coil instrument can be used in both alternating current and direct current measurement. List **four** steps that can explain how it works.

[8 marks]

c) A dynamometer wattmeter with a current coil having resistance of 0.1±0.005 Ω and a pressure coil with a resistance of 6500±10 Ω is connected to a load as shown in Figure 2. The current that flows through the load is 12±0.25 A while the voltage across it is 250±2 V with unity power factor. Find the following along with the limiting error:

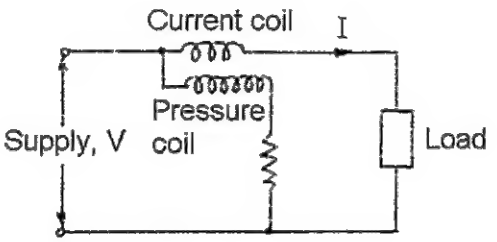

Figure 2

i) Power consumed by load.

[7 marks]

ii) Power lost to the coil

[7 marks]

Continued...

QUESTION 3 [25 MARKS]

a) A Hay bridge in Figure 3 operates at a supply frequency of 100Hz is balanced when the components are $C_3 = 0.1\mu F$, $R_1 = 1.26k\Omega$, $R_3 = 75\ \Omega$ and $R_4 = 500\Omega$. For the measured inductor, calculate:

i) the inductance.

[3 marks]

ii) the resistance.

[3 marks]

iii) Q factor.

[3 marks]

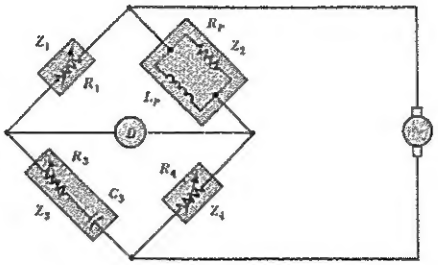

Figure 3

b) Figure 4 shows a Wheatstone bridge circuit with $R_1 = 2k\Omega$, $R_2 = 4k\Omega$, $R_3 = 7k\Omega$ and $R_4 = 20k\Omega$. Given that internal resistance of the galvanometer is 300Ω.

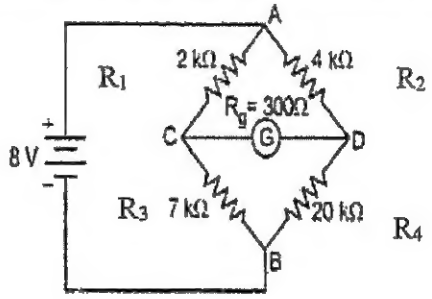

Figure 4

i) What is the condition to achieve balance circuit?

[2 mark]

ii) Is the circuit balanced? Prove.

[2 marks]

iii) Calculate current through the galvanometer as shown above.

[8 marks]

c) In measurement of resistance using substitution method, a standard resistance, S, of 0.5 MΩ is used. The galvanometer resistance is 10 kΩ. When connected to the unknown resistance, R, it will show 41 divisions in the galvanometer. Then, when it is connected to standard resistance, S, the galvanometer shows 51 divisions. Calculate the measured value of R.

[4 marks]

Continued...

QUESTION 4 [25 MARKS]

a) An iron ring with a 15 mm^2 cross-sectional area and a mean length of 0.7 m is wound with a magnetizing winding of 221 turns. A secondary coil with 321 turns of wire is connected to a ballistic galvanometer having a constant of 2 μC per scale division. The total resistance of the secondary circuit is 1.2 kΩ. On reversing a current of 4 A in the magnetizing winding, the galvanometer shows a deflection of 120 scale divisions. Calculate the flux density in the specimen and the value of permeability at this flux density.

[8 marks]

b) A transducer uses two quartz diaphragms of area 750mm^2 separated by a distance of 3.5mm. If the permittivity of quartz is 40.6×10^{-12} F/m, find:

i) The capacitance.

[3 marks]

ii) Proof when the distance is increased to 4mm, the capacitance is also decreased.

[2 marks]

c) A linear potentiometer is 50 mm long and is uniformly wound with a wire having a resistance of 10,000 Ω. Under normal conditions, the wiper is at the center of the potentiometer. Find the linear displacement with reference to the center position if the resistance of the potentiometer is 2300Ω and 5800Ω. Are the two displacements in the same direction?

[5 marks]

d) A platinum resistance thermometer has a resistance of 140.5 Ω and 100.0 Ω at 100°C and 0°C respectively. If the resistance becomes 305.3 Ω when it is in contact with a type of gas, determine the temperature of that gas.

[5 marks]

e) A strain gauge changes resistance in response to an applied force. A nickel wire strain gauge having a Poisson's ratio of -6.55 is compressed and the strain is -4 microstrain. The resistance of the gauge is 100 Ω before being strained three general types of transformer core. Calculate the gauge factor G_f of the gauge if the change in the value of resistivity when it is compressed is negligible.

[2 marks]

End of Page.